DETAILED ACTION

Status of the Claims

1. Claims 1 and 4-19 are pending.

Applicants' amendments filed December 14, 2009 is acknowledged. Applicants' response has been fully considered. Claims 4, 10, 18 and 19 have been amended. Therefore, claims 1 and 4-19 are examined.

Withdrawn Claim Rejections - 35 USC § 102/103

2. The previous rejection of claims 4, 5, 10, 18 and 19 under 35 U.S.C. 102(b) as being anticipated by, or 35 U.S.C. 103(a) as being unpatentable over Tennent *et al* (US 6,099,960), is withdrawn in view of applicants' amendment to the claim, and applicants' response at pages 7-8 in the amendment filed December 14, 2009.

Examiner's Amendment

An **Examiner's Amendment** to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Joseph J. Crimaldi on January 5, 2010.

Examiner's Amendments to the Specification:

Please replace the paragraph inserted at page 1, line 3 of the specification in the amendment filed March 3, 2008 with the following paragraph:

This application is a 371 of PCT/US03/19197, filed June 18, 2003, which claims the benefit of U. S. Provisional Application 60/389,537 filed June 18, 2002, which are hereby incorporated by reference.

Examiner's Amendment to the Claims:

Claims 1, 4, 10, 11, 12, 14, and 16-19 have been amended as follows:

1. (Currently amended) A fibrous protein-immobilization system composition comprising:

a nanofiber comprising a fiber-forming material; and

a protein covalently attached to the fiber-forming material,

wherein the nanofiber includes at least one functional group suitable to permit the attachment of the protein, wherein the at least one function group is contained within a portion of the fiber-forming material, and wherein the fiber-forming materials are linear polymers selected from the group consisting of homopolymers and copolymers of α-olefins, α,β-ethylenicallly unsaturated carboxylic acids, vinyl aromatics, ethyl ethers, and combinations thereof.

4. (Currently amended) A fibrous protein-immobilization system composition comprising:

a nanofiber comprising a fiber-forming material; and

a protein covalently attached to the fiber-forming material,

wherein the nanofiber includes at least one functional group suitable to permit the attachment of the protein, wherein the at least one function group is contained within a portion of the fiber-forming material, wherein the protein is attached directly to the fiber-forming material, and wherein the fiber-forming material is selected from the group consisting of nylons, polyesters, polyurethanes, silanes, or copolymers thereof.

10. (Currently amended) A fibrous protein-immobilization system composition comprising:

a nanofiber comprising a fiber-forming material; and

a protein covalently attached to the fiber-forming material,

wherein the nanofiber includes at least one functional group suitable to permit the attachment of the protein, wherein the at least one function group is contained within a portion of the fiber-forming material, wherein the protein is an enzyme selected from the group consisting of chymotrypsin, cytochrome C, trypsin, subtilisin, horseradish peroxidase, soybean peroxidase, and glucose oxidase, and wherein the fiber-forming material is selected from the group consisting of nylons, polyesters, polyurethanes, silanes, or copolymers thereof.

11. (Currently amended) A method for synthesizing a fibrous protein-immobilization system comprising the steps of:

synthesizing a nanofiber comprising a fiber-forming material, wherein the nanofiber includes at least one functional group suitable to permit the attachment of a protein and wherein the at least one function group is contained within a portion of the fiber-forming material; and

attaching the protein <u>covalently</u> to the fiber-forming material, and

wherein the fiber-forming materials are linear polymers selected from the group consisting of homopolymers and copolymers of α-olefins, α,β-ethylenicallly unsaturated carboxylic acids, vinyl aromatics, ethyl ethers, and combinations thereof.

12. (Currently amended) A method for synthesizing a fibrous protein-immobilization system comprising the steps of:

synthesizing a nanofiber comprising a fiber-forming material, wherein the nanofiber includes at least one functional group suitable to permit the attachment of a protein<u>,</u> ~~and~~ wherein the at least one function group is contained within a portion of the fiber-forming material<u>, and wherein the fiber-forming materials are linear polymers selected from the group consisting of homopolymers and copolymers of α-olefins, α,β-ethylenicallly unsaturated carboxylic acids, vinyl aromatics, ethyl ethers, and combinations thereof</u>; and

attaching the protein <u>covalently</u> to the fiber-forming material,

wherein the protein is attached to the fiber-forming material before the fiber-forming material is synthesized into a nanofiber.

14. (Currently amended) A method for synthesizing a fibrous protein-immobilization system comprising the steps of:

synthesizing a nanofiber comprising a fiber-forming material, wherein the nanofiber includes at least one functional group suitable to permit the attachment of a protein, ~~and~~ wherein the at least one function group is contained within a portion of the fiber-forming material, and wherein the fiber-forming materials are linear polymers selected from the group consisting of homopolymers and copolymers of α-olefins, α,β-ethylenicallly unsaturated carboxylic acids, vinyl aromatics, ethyl ethers, and combinations thereof; and

attaching the protein covalently to the fiber-forming material,

wherein the step of synthesizing includes electrospinning a solution of the fiber-forming material to produce the nanofiber.

16. (Currently amended) A method for synthesizing a fibrous protein-immobilization system comprising the steps of:

synthesizing a nanofiber comprising a fiber-forming material, wherein the nanofiber includes at least one functional group suitable to permit the attachment of a protein, ~~and~~ wherein the at least one function group is contained within a portion of the fiber-forming material, and wherein the fiber-forming materials are linear polymers selected from the group consisting of homopolymers and copolymers of α-olefins, α,β-ethylenicallly unsaturated carboxylic acids, vinyl aromatics, ethyl ethers, and combinations thereof; and

attaching the protein covalently to the fiber-forming material,

wherein the protein is an enzyme and the method further comprises the step of attaching a cofactor to the fiber-forming material or the step of contacting the enzyme with a cofactor in a fluid.

17. (Currently amended) The method of claim 16, ~~further comprising the step of presenting~~ wherein the enzyme is contacted to the cofactor ~~by incorporating the enzyme into~~ in a fluid ~~that contacts the co-factor~~.

18. (Currently amended) A fibrous protein-immobilization system composition comprising:

a nanofiber comprising a fiber-forming material; and

a protein covalently attached to the fiber-forming material;

wherein the nanofiber includes at least one functional group suitable to permit the attachment of the protein; wherein the at least one function group is contained within a portion of the fiber-forming material, wherein the protein is contained within the fiber-forming material, and wherein the fiber-forming material is selected from the group consisting of nylons, polyesters, polyurethanes, silanes, or copolymers thereof.

19. (currently amended) A method for synthesizing a fibrous protein-immobilization system comprising the steps of:

synthesizing a nanofiber comprising a fiber-forming material, wherein the nanofiber includes at least one functional group suitable to permit the attachment of a protein and wherein the at least one function group is contained within a portion of the fiber-forming material; and

attaching the protein covalently to the fiber-forming material,

wherein the protein is contained within the fiber-forming material, and wherein the fiber-forming material is selected from the group consisting of nylons, polyesters, polyurethanes, silanes, or copolymers thereof.

The following is an Examiner's Statement of Reasons for Allowance: The following references are the closest art to the claimed invention. Tennent *et al.* (US 6,099,960) teach a nanofiber comprising carbon, where the continuous carbon fiber are made by pyrolysis of organic precursor fibers usually rayon, polyacrylonitrile (PAN) and pitch, and the graphenic nature of continuous carbon fibers may be subjected to a subsequent graphenation step. This carbon nanofiber is functionalized on the surface carbon of a nanofiber (i.e., $[C_nH_L)$-$A_m)$ so that it may immobilize active groups such as enzymes, antibodies, or antigens. Iyer *et al.* (Abstracts of Papers, 221st ACS national meeting, San Diago, CA, United States, April 1-5, 2001, ANYL-035) teach the use of cellulose nanofiber (30-60 nm diameter) and carbon nanotubes as

immobilized matrixes, enzymes can be site-specifically immobilized onto these supports by protein spacer methods or binding domains (Abstract). For example, subtilisin was site-specifically immobilized onto cellulose nanofibers by a protein spacer method leading to high catalytic efficiency, cellulose nanofibers functionalized with polyamino acid were used for high capacity heavy metal ion capture. However, either Tennent *et al.* or Iyer *et al.* do not teach a fibrous protein-immobilization composition comprising a nanofiber comprising a fiber-forming material; and a protein covalently attached to the fiber-forming material, wherein the nanofiber includes at least one functional group suitable to permit the attachment of the protein, and wherein the fiber-forming materials are linear polymers selected from the group consisting of homopolymers and copolymers of α-olefins, α,β-ethylenicallly unsaturated carboxylic acids, vinyl aromatics, ethyl ethers, and combinations thereof, or wherein the fiber-forming material is selected from the group consisting of nylons, polyesters, polyurethanes, silanes, or copolymers thereof. Therefore, the claims are allowable over the art of record.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chih-Min Kam whose telephone number is (571) 272-0948. The examiner can normally be reached on 8.00-4:30, Mon-Fri.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Manjunath Rao can be reached at 571-272-0939. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Chih-Min Kam/

Primary Examiner, Art Unit 1656

CMK

January 6, 2010